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The Zero ODOL Paradox: Protecting Infrastructure While Increasing Logistics Costs and Commodity Price Pressures

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ABSTRACT

The Zero Over Dimension and Over Loading (Zero ODOL) policy aims to improve transportation safety and protect road infrastructure by limiting freight vehicle dimensions and loads. However, reduced freight capacity may increase shipment requirements and logistics costs, potentially creating pressure on commodity prices. This study examines the potential effects of Zero ODOL on freight capacity, logistics costs, and commodity prices using actual data from 4,093 plastic resin shipments across Java in 2025 and a survey of 229 logistics stakeholders analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM). The results indicate that freight capacity could decrease from 20.88 to 14.07 tons, a 32.64% reduction, potentially increasing shipments to 6,074 and logistics costs by 58.28%. PLS-SEM shows that Freight Capacity Reduction significantly affects Logistics Cost Escalation (β = 0.907), while Logistics Cost Escalation (β = 0.258) and Freight Distance Intensity (β = 0.632) positively affect Potential Price Increases. However, Freight Distance Intensity shows no significant moderating effect on the relationship between Logistics Cost Escalation and Potential Price Increases (β = −0.029). These findings suggest that Zero ODOL may create cost pressures that require improved logistics efficiency to minimize potential impacts on commodity prices.

Keywords: Zero ODOL; freight capacity; logistics costs; freight distance intensity; potential price increases.

INTRODUCTION

Freight transportation plays an important role in maintaining efficient distribution and supply chain operations. However, vehicles that exceed permitted dimensions or loading limits, commonly referred to as Over Dimension and Over Loading (ODOL), can create safety risks and accelerate road infrastructure deterioration. Previous studies have shown that overloaded vehicles can adversely affect pavement conditions and transportation systems (Zofka et al., 2023). In Indonesia, ODOL issues have also been associated with regulatory, safety, infrastructure, and logistics industry readiness (Darmayanti & Dwipayana, 2023; Suryobuwono et al., 2025).

To address these issues, the Indonesian Government has promoted the Zero Over Dimension and Over Loading (Zero ODOL) policy to establish a safer and more sustainable freight transportation system. However, restrictions on vehicle dimensions and loading capacity may reduce effective freight capacity and require additional trips and transportation resources to distribute the same volume of goods. This may increase transportation activities and logistics costs. The issue is particularly relevant as the full implementation of Zero ODOL has been postponed until 2027 due to the need for monitoring mechanisms, supporting infrastructure, and stakeholder readiness (Mendrofa, 2025). Previous studies on ODOL in Indonesia have mainly focused on regulation, safety, infrastructure damage, and policy readiness (Darmayanti & Dwipayana, 2023; Suryobuwono et al., 2025). Meanwhile, international studies indicate that higher transportation and shipping costs can contribute to inflation and commodity price pressures (Michail & Melas, 2022; Carrière-Swallow et al., 2023; Karamperidis et al., 2024). However, limited research has examined the relationship between freight capacity reduction, logistics cost escalation, freight distribution intensity, and potential commodity price increases in the context of Zero ODOL. This study addresses the research gap by integrating actual freight transportation records and survey responses from 229 logistics stakeholders. The operational data are analyzed to assess potential changes in freight capacity, shipment requirements, and logistics costs, while PLS-SEM is applied to evaluate the relationships between FCR, LCE, FDI, and PPI. This study aims to examine the potential operational and economic consequences of Zero ODOL implementation by analysing the relationships among freight capacity reduction, logistics cost escalation, freight distance intensity, and potential commodity price increases. The novelty of this study lies in integrating transportation policy, logistics operations, and potential price effects within a single empirical framework using both actual shipment data and stakeholder perceptions. The study is significant because it provides evidence of the potential economic consequences of reduced freight capacity under Zero ODOL. These findings enrich the literature on freight transportation and logistics while providing useful insights for stakeholders in preparing for Zero ODOL implementation in 2027.

LITERATURE REVIEW

Freight Capacity Reduction

Freight capacity is the amount of goods that can be transported in one trip. Higher capacity can reduce the number of trips required for distribution, while capacity restrictions may require additional trips and transportation resources. In Indonesia, Over Dimension and Over Loading (ODOL) has been associated with safety and infrastructure problems (Abdurachman et al., 2025; Syam et al., 2024). The Zero Over Dimension and Over Loading (Zero ODOL) policy may therefore reduce effective freight capacity.

Logistics Cost Escalation

Logistics costs are influenced by transportation activities, vehicle utilization, and freight capacity. Lower transportation efficiency may increase fuel, labour, and vehicle operating

costs (Galkin et al., 2022; Poliak et al., 2021). Therefore, reduced freight capacity may lead to higher logistics costs, referred to as Logistics Cost Escalation (LCE) in this study.

Freight Distance Intensity
Freight Distance Intensity (FDI) refers to the intensity of transportation activities related to distribution distance. Longer distances generally require more fuel, time, labour, and other transportation resources (Poliak et al., 2021; Galkin et al., 2022). Higher distance intensity may therefore increase distribution costs and create pressure on commodity prices.

Potential Price Increases
Higher logistics and transportation costs may be passed through the supply chain and create pressure on commodity prices. Previous studies have shown that increases in transportation and shipping costs can contribute to inflation and price pressures (Carrière-Swallow, 2023; Alekseievska, 2025). Within the context of this study, Potential Price Increases (PPI) reflect the potential transmission of higher logistics costs to commodity prices.

Hypothesis Development
Freight Capacity Reduction on Logistics Cost Escalation
Reduced freight capacity may require more trips and transportation resources to distribute the same volume of goods. This can increase transportation operating costs. Previous studies have linked vehicle capacity utilization with transportation cost efficiency (Galkin et al., 2022; Poliak et al., 2021). Therefore:
H1: Freight Capacity Reduction has a positive and significant effect on Logistics Cost Escalation.

Logistics Cost Escalation and Potential Price Increases
Higher logistics costs may increase the cost of distributing goods and create pressure on commodity prices. Previous studies have found that higher transportation costs can contribute to price and inflationary pressures (Carrière-Swallow et al., 2023; Alekseievska et al., 2025). Therefore:
H2: Logistics Cost Escalation has a positive and significant effect on Potential Price Increases.

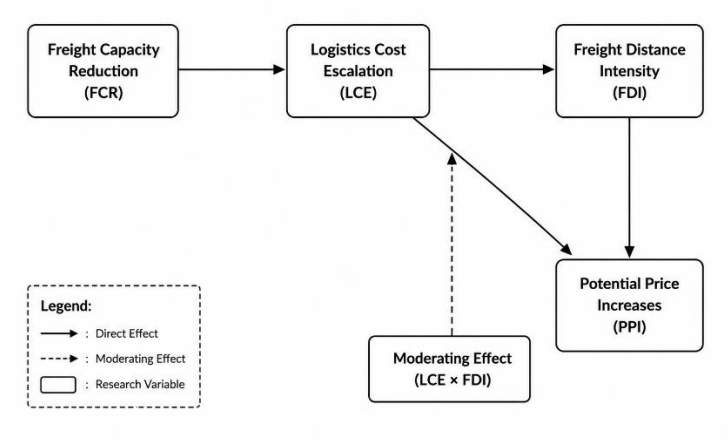
Freight Distance Intensity and Potential Price Increases
Higher freight distance intensity requires more transportation resources and may increase distribution costs. These additional costs may create pressure on commodity prices (Poliak et al., 2021; Galkin et al., 2022). Therefore:
H3: Freight Distance Intensity has a positive and significant effect on Potential Price Increases.

The Moderating Role of Freight Distance Intensity
Freight Distance Intensity may also affect how logistics cost increases are transmitted into commodity price pressures. Higher distance intensity may strengthen the effect of Logistics Cost Escalation on Potential Price Increases. Therefore:
H4: Freight Distance Intensity moderates the relationship between Logistics Cost Escalation and Potential Price Increases.

Conceptual Framework
The proposed conceptual framework illustrates the relationships among the study variables, as presented in Figure 1.

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Figure 1. Research Framework



RESEARCH METHOD

To assess the potential implications of the Zero Over Dimension and Over Loading (Zero ODOL) policy, this study combines two complementary sources of data. Operational records were analysed to identify potential changes in freight capacity, shipment requirements, and logistics costs, whereas survey responses were analysed to assess the relationships between the study constructs using Partial Least Squares Structural Equation Modelling (PLS-SEM). The study analysed **4,093 plastic resin shipments** distributed across Java from January to December 2025. The actual shipment data were compared with a freight capacity scenario based on Zero ODOL requirements to estimate potential changes in freight capacity, shipment requirements, and logistics costs. In addition, a structured questionnaire was distributed to logistics stakeholders with experience or knowledge of freight transportation, distribution, and logistics costs. Respondents were selected using purposive sampling, and **229 respondents** were included in the final analysis. The study examined four constructs: Freight Capacity Reduction (FCR), Logistics Cost Escalation (LCE), Freight Distance Intensity (FDI), and Potential Price Increases (PPI). These constructs were measured using indicators in a structured questionnaire. The operational definitions and measurement indicators are presented in **Table 1**.

Table 1. Operational Definitions

Variable	Operational Definition	Role in the Model
Freight Capacity Reduction (FCR)	Perceptions of a reduction in the effective freight capacity of vehicles as a consequence of adjustments to the Zero ODOL policy.	Exogenous variable
Logistics Cost Escalation (LCE)	Perceptions of increased transportation and distribution costs resulting from changes in freight capacity and operational activities.	Endogenous variable
Freight Distance Intensity (FDI)	The intensity of distribution activities based on freight transportation distance characteristics.	Moderating variable
Potential Price Increases (PPI)	Perceptions of potential increases in commodity prices resulting from logistics and distribution cost pressures.	Endogenous variable

The measurement indicators were used to evaluate the reliability and validity of the research constructs. Actual shipment data were analyzed descriptively to estimate potential changes in freight capacity, shipment requirements, and logistics costs. Survey data were analyzed using PLS-SEM with SmartPLS 4. The measurement model was evaluated through outer loadings, Cronbach's alpha, rho_A, composite reliability, average variance extracted (AVE), and discriminant validity. The structural model was

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subsequently assessed using path coefficients, t-statistics, p-values, R^2, adjusted R^2, and bootstrapping.

RESULTS

Actual Shipment Data Analysis

The operational analysis used actual data from **4,093 plastic resin shipments** distributed across Java in 2025.

Table 2. Summary of Actual Shipment Data Analysis

Indicator	Current Condition	Zero ODOL Scenario	Change
Average freight capacity (tons/shipment)	20,88	14,07	−32.6%
Number of shipments	4,093	6,074	+48.4%
Logistics cost	100%	158,28%	+58.3%

The results show that the Zero ODOL scenario could reduce average freight capacity from **20.88 to 14.07 tons per shipment**, representing a **32.64% reduction**. To distribute the same volume of goods, the number of shipments could increase from **4,093 to 6,074**, while logistics costs could increase by **58.28%**. These results indicate that reduced freight capacity may require additional transportation activities and operational resources.

Figure 2. Potential Changes in Freight Capacity, Shipments, and Logistics Costs

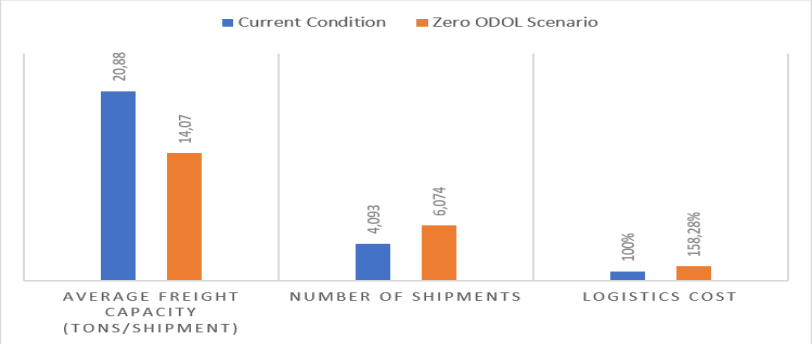


Figure 2 illustrates that the reduction in freight capacity is accompanied by higher shipment requirements and logistics costs.

Respondent Characteristics

The PLS-SEM analysis was based on 229 respondents with involvement in or knowledge of transportation, distribution, and logistics activities. Most respondents were 35–44 years old (43.2%), held a Bachelor's Degree (47.6%), and had 6–10 years of work experience (48.9%). Manufacturers represented the largest company group (40.6%), while 63.8% of respondents reported an average delivery distance of more than 500 km.

Table 3. Selected Respondent Characteristics

Characteristic	Category	n	%
Age	35–44 years	99	43.2
Education	Bachelor's Degree	109	47.6
Position	Logistics Manager	54	23.6
Work Experience	6–10 years	112	48.9
Company Type	Manufacturer	93	40.6
Average Delivery Distance	>500 km	146	63.8
Fleet Size	>100 vehicles	141	61.6

Note: The table presents the main respondent characteristics; percentages are based on the reported survey data.

Measurement Model Assessment

The measurement model was evaluated using **outer loadings, construct reliability, Average Variance Extracted (AVE), and the Fornell-Larcker Criterion**.

Table 4. Measurement Model Results

Construct	Outer Loading Range	Cronbach's Alpha	Composite Reliability	AVE
FCR	0.785–0.918	0.957	0.964	0.770
FDI	0.821–0.905	0.964	0.969	0.771
LCE	0.857–0.918	0.962	0.968	0.798
PPI	0.858–0.904	0.957	0.964	0.778

The outer loading values ranged from **0.785 to 0.918**, indicating that all indicators met the minimum acceptable level. Cronbach's Alpha and Composite Reliability values were above **0.90**, while all AVE values exceeded **0.50**. These results indicate adequate internal consistency and convergent validity of the constructs.

Table 5. Fornell-Larcker Criterion

Construct	FCR	FDI	LCE	PPI
FCR	0.877			
FDI	0.907	0.878		
LCE	0.907	0.925	0.893	
PPI	0.880	0.919	0.879	0.882

The Fornell-Larcker results show high correlations among several constructs. In particular, the correlations between FCR and LCE (**0.907**), FDI and LCE (**0.925**), and FDI and PPI (**0.919**) are relatively high.

Structural Model Assessment

The structural model was evaluated using **R^2, effect size (f^2), path coefficients, and bootstrapping results**.

Table 6. R^2 and Effect Size

Endogenous Construct	R^2	Main Relationship	f^2
LCE	0.823	FCR → LCE	4.664
PPI	0.855	FDI → PPI	0.325
PPI	0.855	LCE → PPI	0.065
PPI	0.855	LCE × FDI → PPI	0.007

FCR accounts for 82.3% of the variance in LCE, while LCE, FDI, and their interaction collectively explain approximately 85.5% of the variance in PPI. The strongest effect is found for FCR → LCE (f^2 = 4.664), whereas the interaction effect contributes only minimally (f^2 = 0.007).

Hypothesis Testing

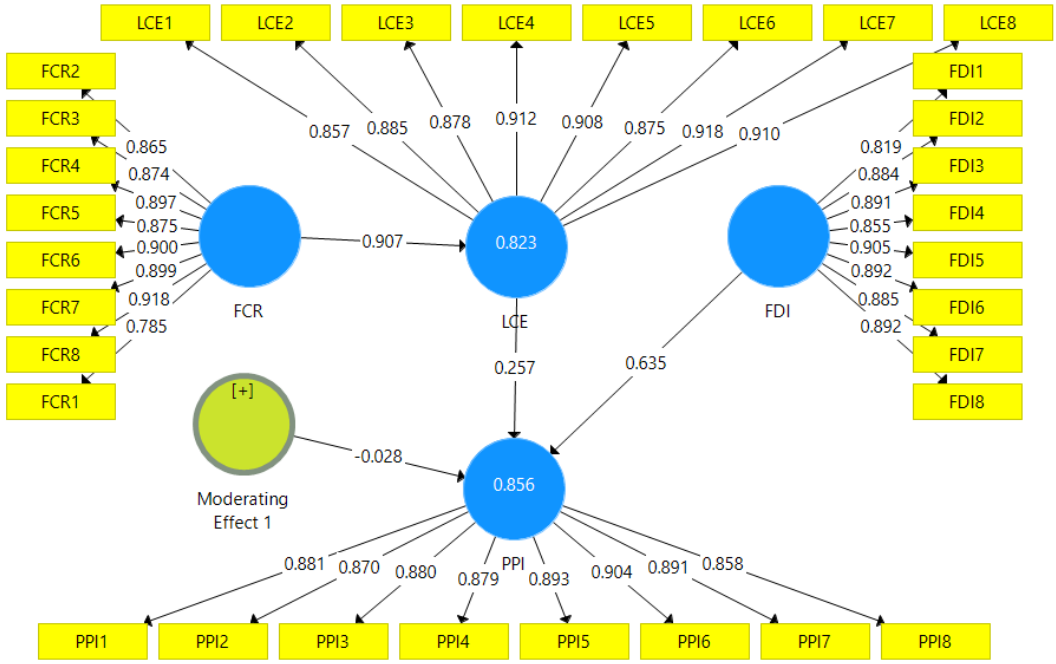
Table 7. Hypothesis Testing Results

Hypothesis	Relationship	β	t-value	p-value	Decision
H1	FCR → LCE	0.907	36.417	<0.001	Supported
H2	LCE → PPI	0.257	2.220	0.026	Supported
H3	FDI → PPI	0.635	5.798	<0.001	Supported
H4	LCE × FDI → PPI	−0.028	0.765	0.444	Not Supported

The hypothesis testing indicates that FCR significantly and positively influences LCE (β = 0.907, $p < 0.001$), thereby supporting H1. Similarly, LCE shows a significant positive relationship with PPI (β = 0.257, p = 0.026), providing support for H2. The results show that FDI has a significant positive direct effect on PPI (β = 0.635, $p < 0.001$), supporting H3. However, the interaction between LCE and FDI does not have a statistically significant effect on PPI (β = −0.028, p = 0.444), and therefore H4 is not supported.

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Figure 3. PLS-SEM Bootstrapping Results



The PLS-SEM results indicate a clear relationship between freight capacity and logistics costs. The strong coefficient from FCR to LCE suggests that reductions in freight capacity are closely associated with higher logistics costs. LCE and FDI both have significant direct effects on PPI, while the interaction effect is not significant. Thus, FDI appears to influence potential price increases directly rather than by changing the strength of the relationship between logistics costs and potential price increases.

DISCUSSION

This study examines the potential implications of the Zero Over Dimension and Over Loading (Zero ODOL) policy for freight transportation capacity, logistics costs, and potential commodity price increases. The findings indicate that restrictions on vehicle dimensions and loading capacity may reduce the amount of freight that can be transported in a single shipment. Consequently, additional transportation movements may be required to accommodate the same volume of cargo, potentially increasing transportation requirements and overall logistics costs. The results further show that higher logistics costs are positively associated with potential price increases, indicating that additional transportation costs may create cost pressures that can potentially be transmitted along the supply chain. Freight distance intensity also demonstrates a significant direct relationship with potential price increases, suggesting that transportation distance is an important factor in the potential escalation of commodity prices. However, freight distance intensity does not significantly alter the relationship between logistics cost escalation and potential price increases. This indicates that, although transportation distance is directly associated with potential price pressures, its role as a moderating factor in the transmission of logistics cost increases to potential price increases is limited.

The Effect of Freight Capacity Reduction on Logistics Cost Escalation

The results support H1, showing that Freight Capacity Reduction (FCR) has a strong positive effect on Logistics Cost Escalation (LCE) (β = 0.907). The actual data show a potential reduction in freight capacity from 20.88 to 14.07 tons, an increase in shipments from 4,093 to 6,074, and a 58.28% increase in logistics costs. Lower freight capacity

requires more trips and operational resources, which can increase fuel, labor, and vehicle costs. This finding is consistent with previous research linking transportation capacity and distribution efficiency to logistics costs (Rodrigue, 2020; Swanson et al., 2022).

The Effect of Logistics Cost Escalation on Potential Price Increases

H2 is supported, with LCE having a positive effect on Potential Price Increases (PPI) (β = 0.258). Higher transportation costs may create pressure within the supply chain and may be partially transferred to product prices. However, the 58.28% potential increase in logistics costs does not imply the same increase in commodity prices because companies may absorb part of the additional costs through efficiency improvements or lower margins. This finding is consistent with previous research on transportation costs and price pressures (UNCTAD, 2021; Carrière-Swallow, 2023)

The Effect of Freight Distance Intensity on Potential Price Increases

H3 is supported, as Freight Distance Intensity (FDI) has a positive effect on PPI (β = 0.632). Longer distribution distances require greater use of fuel, vehicles, time, and other logistics resources. The stronger effect of FDI compared with LCE suggests that distribution distance is an important factor in explaining potential price pressures, particularly for long-distance freight movements. This finding is consistent with research emphasizing the role of geographical distance and distribution characteristics in transportation costs and efficiency (Rodrigue, 2020; Christopher, 2022).

The Moderating Role of Freight Distance Intensity

The findings do not support H4, as FDI does not significantly alter the relationship between LCE and PPI (β = −0.029). Despite its significant direct effect on PPI, FDI does not appear to strengthen or weaken the influence of logistics cost escalation on potential price increases. This finding suggests that the presence of a significant direct relationship does not necessarily indicate a significant moderating effect, consistent with the principles discussed in the PLS-SEM literature (Hair et al., 2022; Becker et al., 2023). The transmission of logistics costs to prices may also be affected by other factors, including pricing strategies, market competition, and the extent to which additional costs are absorbed by firms.

Managerial Implications, Limitations, and Future Research

The findings suggest that logistics companies should improve vehicle utilization, route planning, and trip consolidation to manage the impact of reduced freight capacity. Policymakers should complement Zero ODOL with supporting transportation infrastructure and multimodal alternatives, particularly rail freight for high-volume and long-distance distribution. Previous research also highlights the potential role of rail and multimodal transportation in improving logistics efficiency (Halim, 2022; Hidayati et al., 2025). This study is limited to plastic resin shipments across Java and a stakeholder survey. Future research should examine other commodities and regions and validate these findings using actual post-implementation Zero ODOL data.

CONCLUSION

This study concludes that the implementation of the Zero Over Dimension and Over Loading (Zero ODOL) policy has important implications for freight transportation capacity, logistics costs, and the potential transmission of transportation costs to commodity prices. The findings indicate that restricting vehicle dimensions and loading capacity may reduce the amount of freight that can be transported per shipment, consequently requiring a greater number of transportation movements to accommodate the same level of cargo demand. This condition may increase operational requirements

and contribute to higher logistics costs, particularly when transportation capacity is not accompanied by improvements in vehicle utilization and transport planning.
The empirical findings further demonstrate that Freight Capacity Reduction (FCR) has a strong positive effect on Logistics Cost Escalation (LCE), indicating that reductions in freight capacity are closely associated with increasing logistics costs. Logistics Cost Escalation also has a significant positive relationship with Potential Price Increases (PPI), suggesting that higher transportation costs may create additional cost pressures that can potentially be transmitted to commodity prices. In addition, Freight Distance Intensity (FDI) has a significant direct effect on PPI, indicating that transportation distance is an important factor associated with potential price pressures. However, the interaction between LCE and FDI is not statistically significant. This finding suggests that although freight distance intensity has a direct relationship with potential price increases, it does not significantly strengthen or weaken the relationship between logistics cost escalation and potential price increases.

These findings imply that the successful implementation of Zero ODOL should not rely solely on regulatory restrictions on vehicle dimensions and loading capacity. The policy should be accompanied by measures that improve transportation and logistics efficiency, particularly through better vehicle utilization, route optimization, shipment consolidation, transport planning, and the reduction of empty or inefficient trips. The development of alternative freight transportation modes, including rail-based and multimodal transportation, may also provide additional capacity and help mitigate potential cost pressures. Such supporting measures are important to ensure that improvements in road safety and infrastructure protection do not unintentionally create excessive operational burdens for logistics operators and downstream commodity supply chains.

From a policy perspective, the findings highlight the importance of adopting a balanced approach to Zero ODOL implementation. Policymakers and logistics stakeholders should consider not only compliance with vehicle loading restrictions but also the broader effects on freight capacity, transportation frequency, logistics costs, and commodity distribution. Operational readiness, adequate freight capacity, and efficient transportation networks should therefore be strengthened alongside regulatory enforcement. This approach may help reduce the potential economic consequences of the policy while maintaining its objectives of improving road safety, protecting infrastructure, and promoting more sustainable freight transportation.

Future research should extend the analysis to other commodity groups, geographic regions, and transportation corridors to examine whether the observed relationships remain consistent across different logistics contexts. Further studies should also incorporate actual post-implementation operational and cost data following the full implementation of Zero ODOL to validate the potential effects identified in this study. In addition, future research could consider other factors that may influence commodity price increases, such as fuel prices, market demand, vehicle operating costs, distribution margins, and pricing strategies. Incorporating these factors would provide a more comprehensive understanding of how Zero ODOL implementation may influence logistics costs and commodity prices across the supply chain.

LIMITATION

This study has several limitations that should be considered when interpreting its findings. First, the operational analysis focuses specifically on plastic resin shipments in Java. Although this commodity provides a relevant case for examining the potential implications of Zero ODOL, its transportation characteristics, shipment patterns, and logistics requirements may differ from those of other commodities. Therefore, the

findings may not be directly generalizable to agricultural products, construction materials, consumer goods, or other types of freight transported in different regions.

Second, the analysis of the potential impact of Zero ODOL is based on a comparison scenario and stakeholder perceptions rather than observations of actual post-implementation conditions. The study therefore estimates potential changes in freight capacity, transportation requirements, and logistics costs rather than measuring the actual outcomes following full implementation of the policy. Consequently, the results should be interpreted as evidence of potential impacts rather than definitive measurements of the realized effects of Zero ODOL.

Third, the empirical analysis relies on operational transportation records for a specific observation period and survey responses collected from logistics stakeholders. Changes in market conditions, transportation demand, fuel prices, vehicle operating costs, and logistics practices over time may influence the relationships identified in the study. As a result, the findings may not fully capture longer-term adjustments that logistics operators could make in response to the implementation of Zero ODOL.

Fourth, the PLS-SEM model focuses on the relationships among Freight Capacity Reduction (FCR), Logistics Cost Escalation (LCE), Freight Distance Intensity (FDI), and Potential Price Increases (PPI). Other factors that may influence logistics costs and commodity prices are not explicitly incorporated into the model. These factors may include fuel price fluctuations, labor costs, vehicle maintenance expenses, market demand, commodity prices, distribution margins, pricing strategies, and competition within the logistics and commodity markets. The exclusion of these variables may limit the model's ability to capture the full complexity of the relationship between transportation costs and potential price increases.

Fifth, although the study incorporates stakeholder perceptions to complement the operational analysis, perceptions may be influenced by respondents' professional experience, organizational roles, expectations, and understanding of the Zero ODOL policy. Such perceptual differences may introduce a degree of subjectivity into the survey-based findings. Therefore, the results from the stakeholder survey should be interpreted as representing the perspectives of the participating respondents rather than as a complete representation of all logistics stakeholders in Indonesia.

Finally, the study examines the potential relationship between logistics costs and potential commodity price increases but does not directly measure the actual extent to which additional transportation costs are transferred to final commodity prices. The degree of cost pass-through may depend on the bargaining position of logistics providers, manufacturers, distributors, and customers, as well as market competition and pricing strategies. Therefore, the observed relationship between LCE and PPI should not be interpreted as evidence that increases in logistics costs will automatically result in equivalent increases in commodity prices.

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DECLARATION

The authors declare that this study was carried out independently and without any financial, personal, professional, or institutional interests that could have affected the research process or its outcomes. No competing interests were identified in relation to the authorship, preparation, review, or publication of this manuscript. The authors therefore confirm that the findings and conclusions reported in this article are presented independently of any external influence.

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